RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
Lopatcong Township, Warren County, New Jersey

Prepared for Lopatcong Township by the
Rutgers Cooperative Extension Water Resources Program

February 19, 2015

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FOUNDATION

Introduction

Pervious and impervious are terms that are used to describe the ability or inability of water to flow through a surface. When rainfall hits a surface, it can soak into the surface or flow off the surface. Pervious surfaces are those which allow stormwater to readily soak into the soil and recharge groundwater. When rainfall drains from a surface, it is called "stormwater" runoff (Figure 1). An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the volume of stormwater runoff.

Figure 1: Stormwater draining from a parking lot

New Jersey has many problems due to stormwater runoff, including:

- Pollution: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired, with urban-related stormwater runoff listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants, including animal waste, excess fertilizers, and pesticides and other toxic substances. These pollutants are then able to enter waterways.

- Flooding: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused has also increased greatly with this trend, costing billions of dollars over this time span.

- Erosion: Increased stormwater runoff causes an increase in the velocity of flows in our waterways. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

The primary cause of the pollution, flooding, and erosion problems is the quantity of impervious surfaces draining directly to local waterways. New Jersey is one of the most developed states in the country. Currently, the state has the highest percent of impervious cover in the country at 12.1% of its total area (Nowak & Greenfield, 2012). Many of these impervious surfaces are directly connected to local waterways (i.e., every drop of rain that lands on these impervious surfaces ends up in a local river, lake, or bay without any chance of being treated or soaking into the ground). To repair our waterways, reduce flooding, and stop erosion, stormwater runoff from impervious surfaces has to be better managed. Surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

The first step to reducing the impacts from impervious surfaces is to conduct an impervious cover assessment. This assessment can be completed on different scales: individual lot, municipality, or watershed. Impervious surfaces need to be identified for stormwater management. Once impervious surfaces have been identified, there are three steps to better manage these surfaces.

1. ***Eliminate surfaces that are not necessary.*** For example, a paved courtyard at a public school could be converted to a grassed area.

2. ***Reduce or convert impervious surfaces.*** There may be surfaces that are required to be hardened, such as roadways or parking lots, but could be made smaller and still be functional. A parking lot that has two-way cart ways could be converted to one-way cart ways. There also are permeable paving materials such as porous asphalt, pervious concrete, or permeable paving stones that could be substituted for impermeable paving materials (Figure 2).

3. ***Disconnect impervious surfaces from flowing directly to local waterways.*** There are many ways to capture, treat, and infiltrate stormwater runoff from impervious surfaces. Opportunities may exist to reuse this captured water.

Figure 2: Rapid infiltration of water through porous pavement is demonstrated at the USEPA Edison New Jersey test site

Lopatcong Township Impervious Cover Analysis

Located in Warren County, New Jersey, Lopatcong Township covers approximately 7.16 square miles east of Pennsylvania and the Delaware River. Figures 3 and 4 illustrate that Lopatcong Township is dominated by urban land uses. Approximately 48.4% of the municipality's land use is classified as urban. Of the urban land in Lopatcong Township, medium density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious surface cover (Schueler, 1994; Arnold and Gibbons, 1996; May et al., 1997). Impervious cover may be linked to the quality of lakes, reservoirs, estuaries, and aquifers (Caraco et al., 1998), and the amount of impervious cover in a watershed can be used to project the current and future quality of streams. Based on the scientific literature, Caraco et al. (1998) classified urbanizing streams into the following three categories: sensitive streams, impacted streams, and non-supporting streams. Sensitive steams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Lopatcong Township into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Lopatcong Township. Based upon the 2007 NJDEP land use/land cover data, approximately 12.5% of Lopatcong Township has impervious cover. This level of impervious cover suggests that the streams in Lopatcong Township are likely impacted.

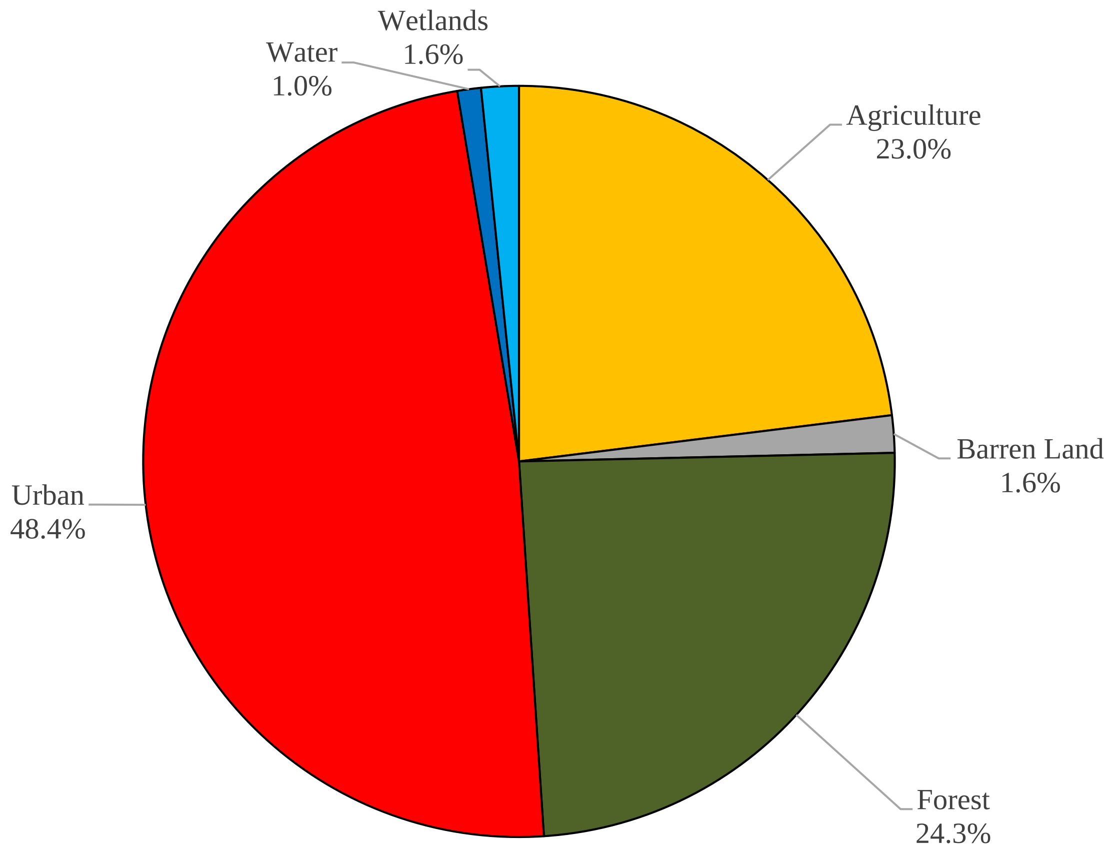


Figure 3: Pie chart illustrating the land use in Lopatcong Township

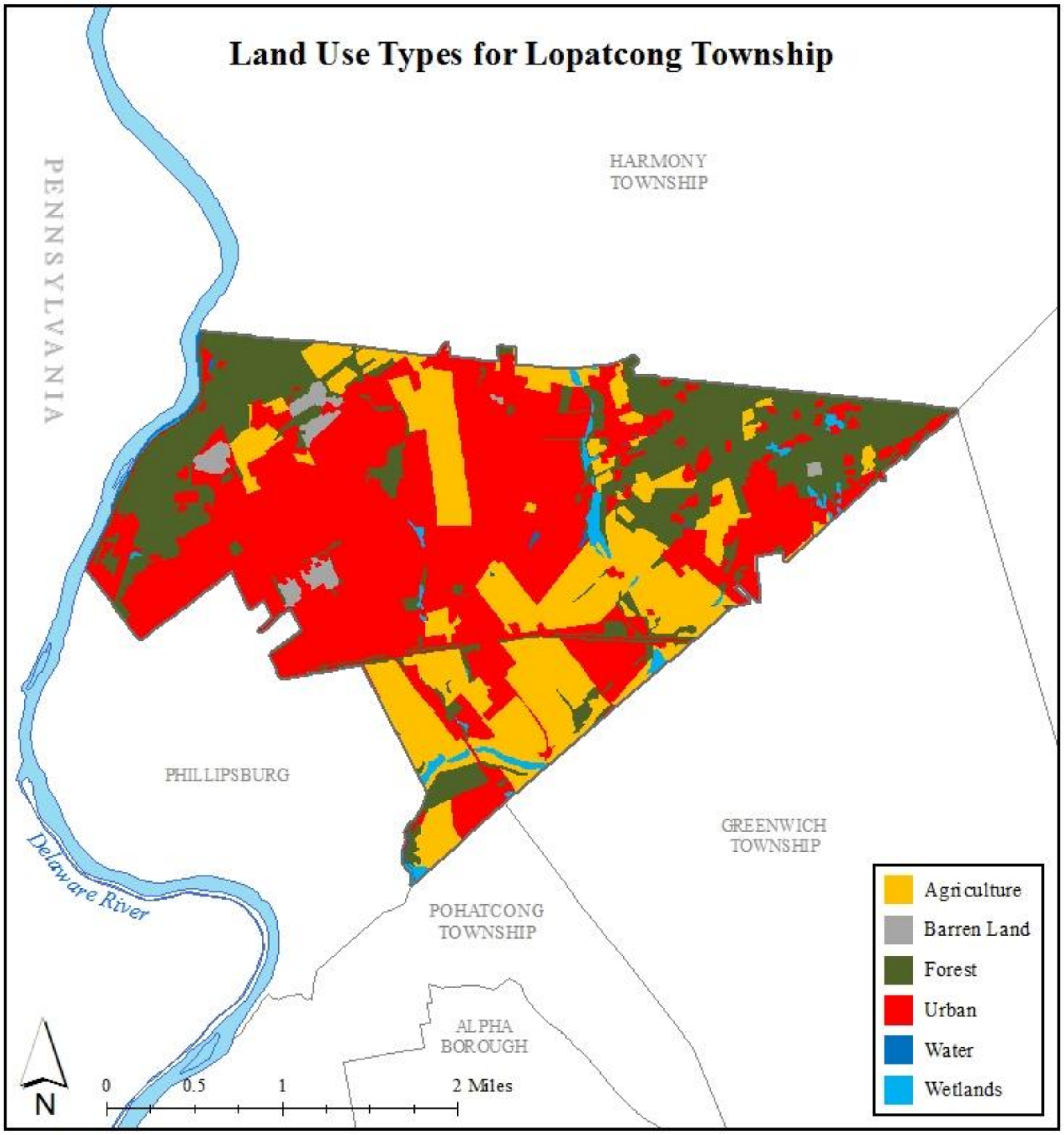


Figure 4: Map of the land use in Lopatcong Township

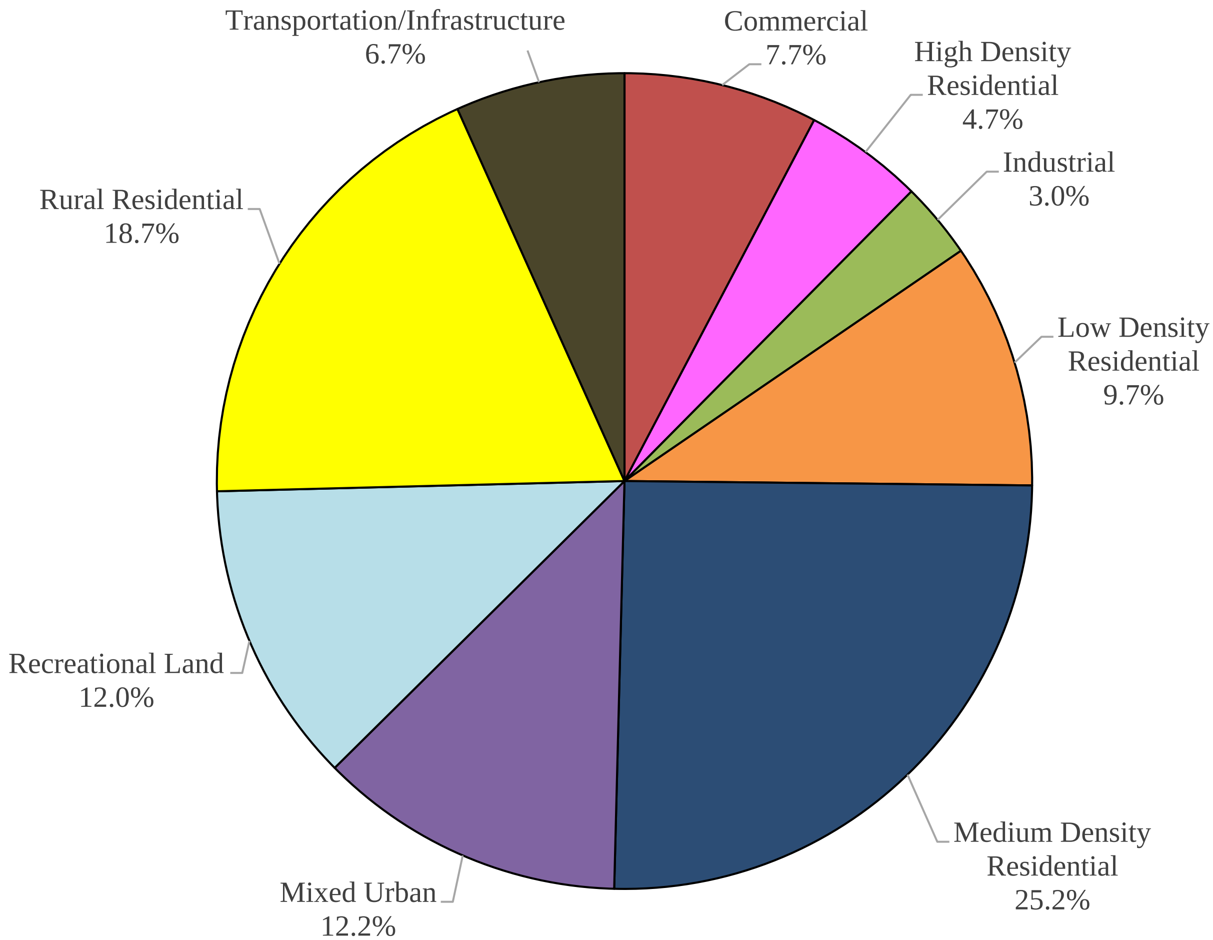


Figure 5: Pie chart illustrating the various types of urban land use in Lopatcong Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Lopatcong Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 3.2% in the Merrill Creek subwatershed to 13.6% in the Lopatcong Creek subwatershed. Evaluating impervious cover on a subwatershed basis allows the municipality to focus impervious cover reduction or disconnection efforts in the subwatersheds where frequent flooding occurs.

In developed landscapes, stormwater runoff from parking lots, driveways, sidewalks, and rooftops flows to drainage pipes that feed the sewer system. The cumulative effect of these impervious surfaces and thousands of connected downspouts reduces the amount of water that can infiltrate into soils and greatly increases the volume and rate of runoff that flows to waterways. Stormwater runoff volumes (specific to Lopatcong Township, Warren County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (4.9 inches of rain), and the 100-year design storm (7.8 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Lopatcong Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lopatcong Creek subwatershed was harvested and purified, it could supply water to 149 homes for a year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Lopatcong Township

Subwatershed	**Total Area**		**Land Use Area**		**Water Area**		**Impervious Cover**		
	(ac)	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(%)**
Lopatcong Creek	3,535.0	5.52	3,529.0	5.51	5.8	0.01	481.3	0.75	13.6%
Merrill Creek	312.7	0.49	312.6	0.49	0.1	0.00	10.1	0.02	3.2%
UDRV Tributary	870.7	5.52	828.7	5.51	42.0	0.01	97.2	0.75	11.2%
TOTAL	4,718.4	11.54	4,670.3	11.52	47.9	0.02	588.6	1.52	12.5%

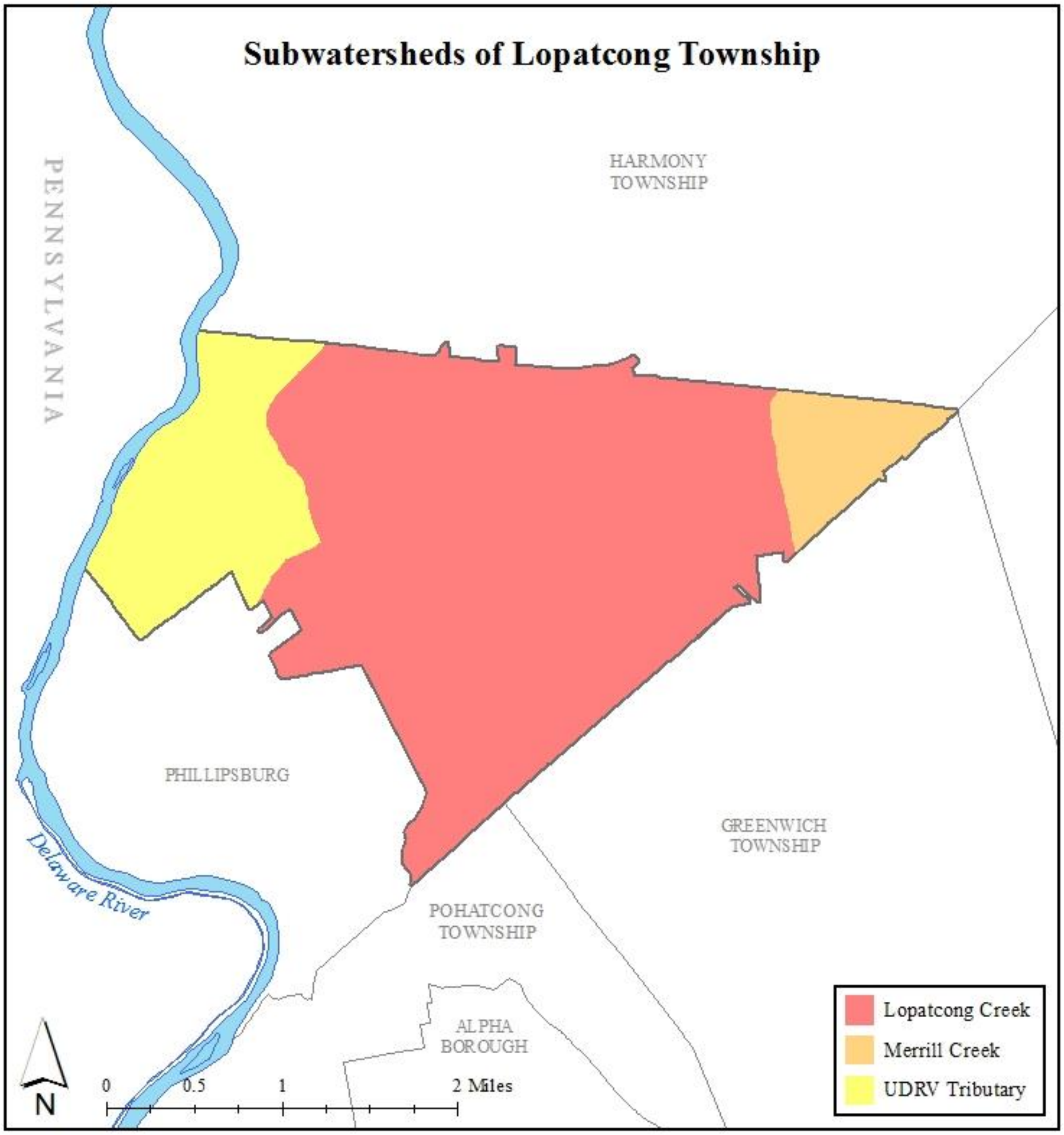


Figure 6: Map of the subwatersheds in Lopatcong Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Lopatcong Township

Subwatershed	**Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)**	**Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)**	**Total Runoff Volume for the 2-Year Design Storm (3.3") (MGal)**	**Total Runoff Volume for the 10-Year Design Storm (4.9") (MGal)**	**Total Runoff Volume for the 100-Year Design Storm (7.8") (MGal)**
Lopatcong Creek	16.3	575.0	43.1	64.0	101.9
Merrill Creek	0.3	12.0	0.9	1.3	2.1
UDRV Tributary	3.3	116.1	8.7	12.9	20.6
TOTAL	20.0	703.1	52.7	78.3	124.6

The next step is to set a reduction goal for impervious area in each subwatershed. Based upon the Rutgers Cooperative Extension (RCE) Water Resources Program's experience, a 10% reduction would be a reasonably achievable reduction for these subwatersheds in Lopatcong Township. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.3 inches of rain over 24-hours). Although this results in management practices that are slightly over-designed by NJDEP standards, which require systems to be designed for the New Jersey water quality storm (1.25 inches of rain over 2-hours), these systems will be able to handle the increase in storm intensities that are expected to occur due to climate change. By designing these management practices for the 2-year design storm, these practices will be able to manage 95% of the annual rainfall volume. The recommended annual reductions in runoff volumes are shown in Table 3.

As previously mentioned, once impervious surfaces have been identified, there next steps for managing impervious surfaces are to 1) eliminate surfaces that are not necessary, 2) reduce or convert impervious surfaces to pervious surfaces, and 3) disconnect impervious surfaces from flowing directly to local waterways.

Elimination of Impervious Surfaces

One method to reduce impervious cover is to "depave." Depaving is the act of removing paved impervious surfaces and replacing them with pervious soil and vegetation that will allow for the infiltration of rainwater. Depaving leads to the re-creation of natural space that will help reduce flooding, increase wildlife habitat, and positively enhance water quality as well as beautify neighborhoods. Depaving also can bring communities together around a shared vision to work together to reconnect their neighborhood to the natural environment.

Table 3: Impervious cover reductions by watershed in Lopatcong Township

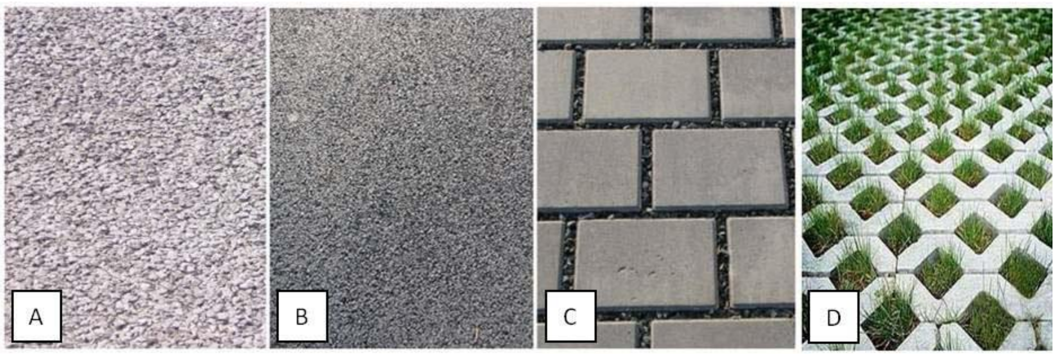
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction [2] (MGal)
Lopatcong Creek	48.1	54.6
Merrill Creek	1.0	1.1
UDRV Tributary	9.7	11.0
TOTAL	58.9	66.8

[2] Annual Runoff Volume Reduction =
Acres of impervious cover x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) x (1 MGal/1,000,000 gal)
All green infrastructure should be designed to capture the first 3.3 inches of rain from each storm. This would allow the green infrastructure to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

There are four different types of permeable pavement systems that are commonly being used throughout the country to reduce the environmental impacts from impervious surfaces. These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers.

> "*Permeable pavement is a stormwater drainage system that allows rainwater and runoff to move through the pavement's surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce stormwater volume, treat stormwater water quality, replenish the groundwater supply, and lower air temperatures on hot days (Rowe, 2012).*"



Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)

Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water, allowing it to infiltrate into the underlying uncompacted soil.

Impervious Cover Disconnection Practices

By redirecting runoff from paving and rooftops to pervious areas in the landscape, the amount of directly connected impervious area in a drainage area can be greatly reduced. There are many cost-effective ways to disconnect impervious surfaces from local waterways.

- Simple Disconnection: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect and treat a variety of impervious surfaces (Figure 7).

Figure 7: Rain garden outside the RCE of Gloucester County office which was designed to disconnect rooftop runoff from the local storm sewer system

- Rainwater Harvesting: Rainwater harvesting includes the use of rain barrels and cisterns (Figures 8a and 8b). These can be placed below downspouts to collect rooftop runoff. The collected water has a variety of uses including watering plants and washing cars. This practice also helps cut down on the use of potable water for nondrinking purposes. It is important to divert the overflow from the rainwater harvesting system to a pervious area.

Figure 8a: Rain barrel used to disconnect a downspout with the overflow going to flower bed

Figure 8b: A 5,000 gallon cistern used to disconnect the rooftop of the Department of Public Works in Clark Township to harvest rainwater for nonprofit car wash events

Examples of Opportunities in Lopatcong Township

To address the impact of stormwater runoff from impervious surfaces the next step is to identify opportunities in the municipality for eliminating, reducing, or disconnecting directly connected impervious surfaces. To accomplish this task, an impervious cover reduction action plan should be prepared. Aerial photographs are used to identify sites with impervious surfaces in the municipality that may be suitable for inclusion in the action plan. After sites are identified, site visits are conducted to photo-document all opportunities and evaluate the feasibility of eliminating, reducing, or disconnecting directly connected impervious surfaces. A brief description of each site discussing the existing conditions and recommendations for treatment of the impervious surfaces is developed. After a number of sites have been selected for inclusion in the action plan, concept plans and detailed green infrastructure information sheets are prepared for a selection of representative sites.

For Lopatcong Township, three sites have been included in this assessment. Examples of concept plans and detailed green infrastructure information sheets are provided in Appendix A. The detailed green infrastructure information sheets describe existing conditions and issues, proposed solutions, anticipated benefits, possible funding sources, potential partners and stakeholders, and estimated costs. Additionally, each project has been classified as a mitigation opportunity for recharge potential, total suspended solids removal, and stormwater peak reduction. Finally, these detailed green infrastructure information sheets provide an estimate of gallons of stormwater captured and treated per year by each proposed green infrastructure practice. The concept plans provide an aerial photograph of the site and details of the proposed green infrastructure practices.

Conclusions

Lopatcong Township can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. This impervious cover assessment is the first step toward better managing stormwater runoff. The next step is to develop an action plan to eliminate, reduce, or disconnect impervious surfaces where possible and practical. Many of the highly effective disconnection practices are inexpensive. The entire community can be engaged in implementing these disconnection practices.

References

Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

Caraco, D., R. Claytor, P. Hinkle, H. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.G. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. *Watershed Protection Techniques* 2(4): 483-493.

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.
http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.
http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques*1(3): 100-111.

United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.
http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

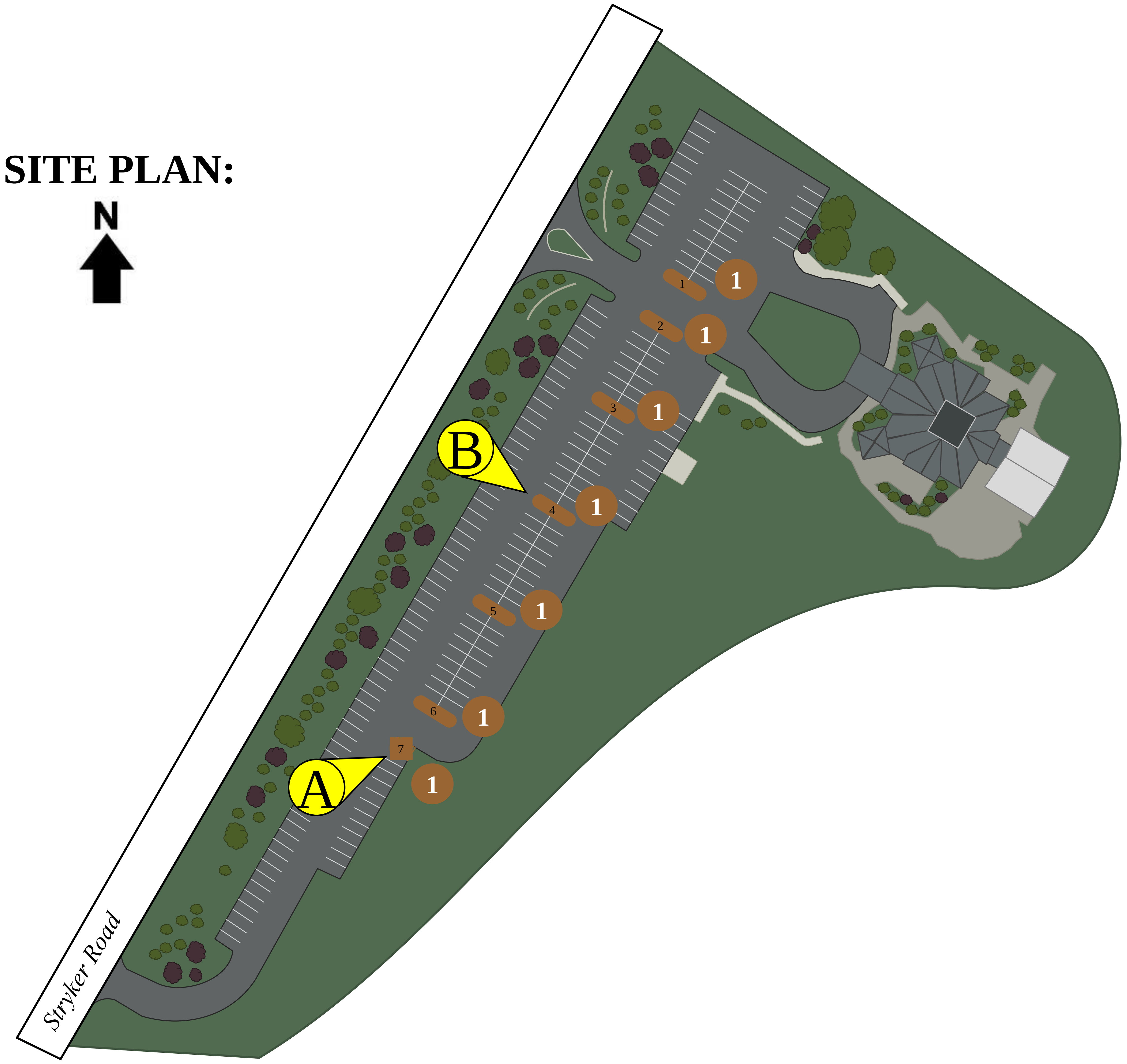
Lopatcong Township
Impervious Cover Assessment
Architects Golf Club, 700 Stryker Road

PROJECT LOCATION:

A

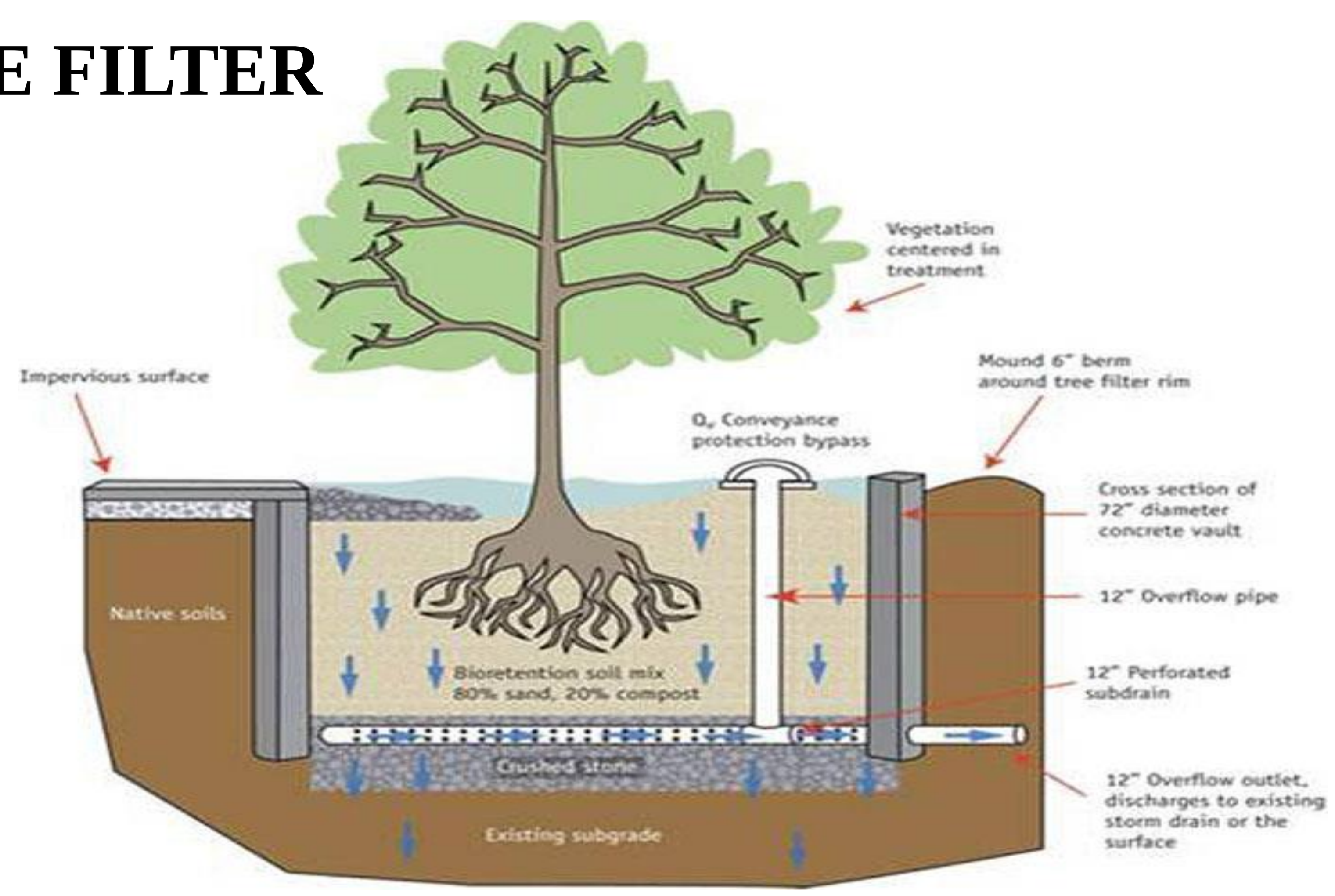
B

SITE PLAN:



1 **TREE FILTER BOX:** The islands that are currently located in the parking lot could be converted to tree filter boxes. These tree boxes could capture, treat, and infiltrate runoff from the parking lot. Any excess runoff would be conveyed to the existing catch basins through an overflow bypass system. The tree boxes could reduce sediment and nutrient loading to the local waterway while accentuating the property's beautiful landscaping.

1 TREE FILTER BOX



Location: 700 Stryker Road Phillipsburg, NJ 08865	**Municipality:** Lopatcong Township **Subwatershed:** Lopatcong Creek
Green Infrastructure Description: tree filter boxes	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** tree filter box # 1: 33,400 gal. tree filter box # 2: 169,400 gal. tree filter box # 3: 169,400 gal. tree filter box # 4: 169,400 gal. tree filter box # 5: 135,500 gal. tree filter box # 6: 67,700 gal. tree filter box # 7: 237,100 gal.

Existing Conditions and Issues:
This site hosts extensive impervious surfaces, namely paved walkways, driveways, and a large parking area. These impervious surfaces are directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. The parking lot is the largest impervious surface at the site. Sediment accumulation was observed around the catch basins throughout the parking lot. The pavement is in good condition; depaving is not recommended.

Proposed Solution(s):
A large portion of the stormwater runoff from the parking lot could effectively be managed through the implementation of tree filter boxes. The existing storm sewer system could be used to capture overflow from the systems. The tree filter box would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. Tree boxes would be installed in each of the tree islands which currently exist within the parking lot.

Anticipated Benefits:
Tree filter boxes can capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours) and treat individual drainage areas as large as 10,000 square feet. These systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The tree filter boxes would provide ancillary benefits such as enhanced aesthetic appeal to the golf club.

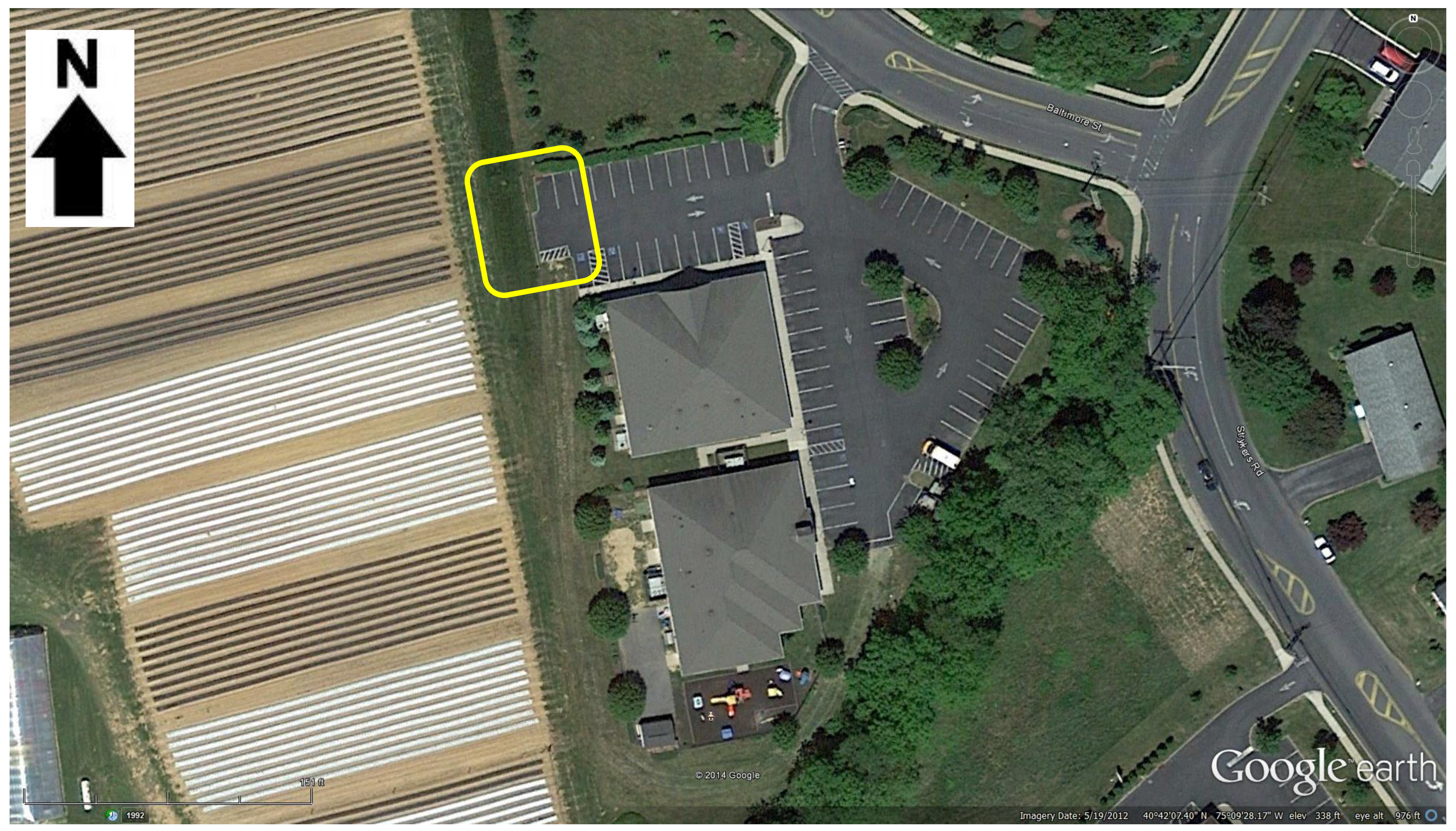
Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
local social and community groups

Partners/Stakeholders:
Lopatcong Township
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension
The Architects Golf Club and its members

Estimated Cost:
Each 6′ x 6′ tree filter box costs $7,500. The total cost of the project would be approximately $52,500.

Lopatcong Township
Impervious Cover Assessment
St. Luke's Village Health Center, 205 Stryker Road

PROJECT LOCATION:



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SITE PLAN:

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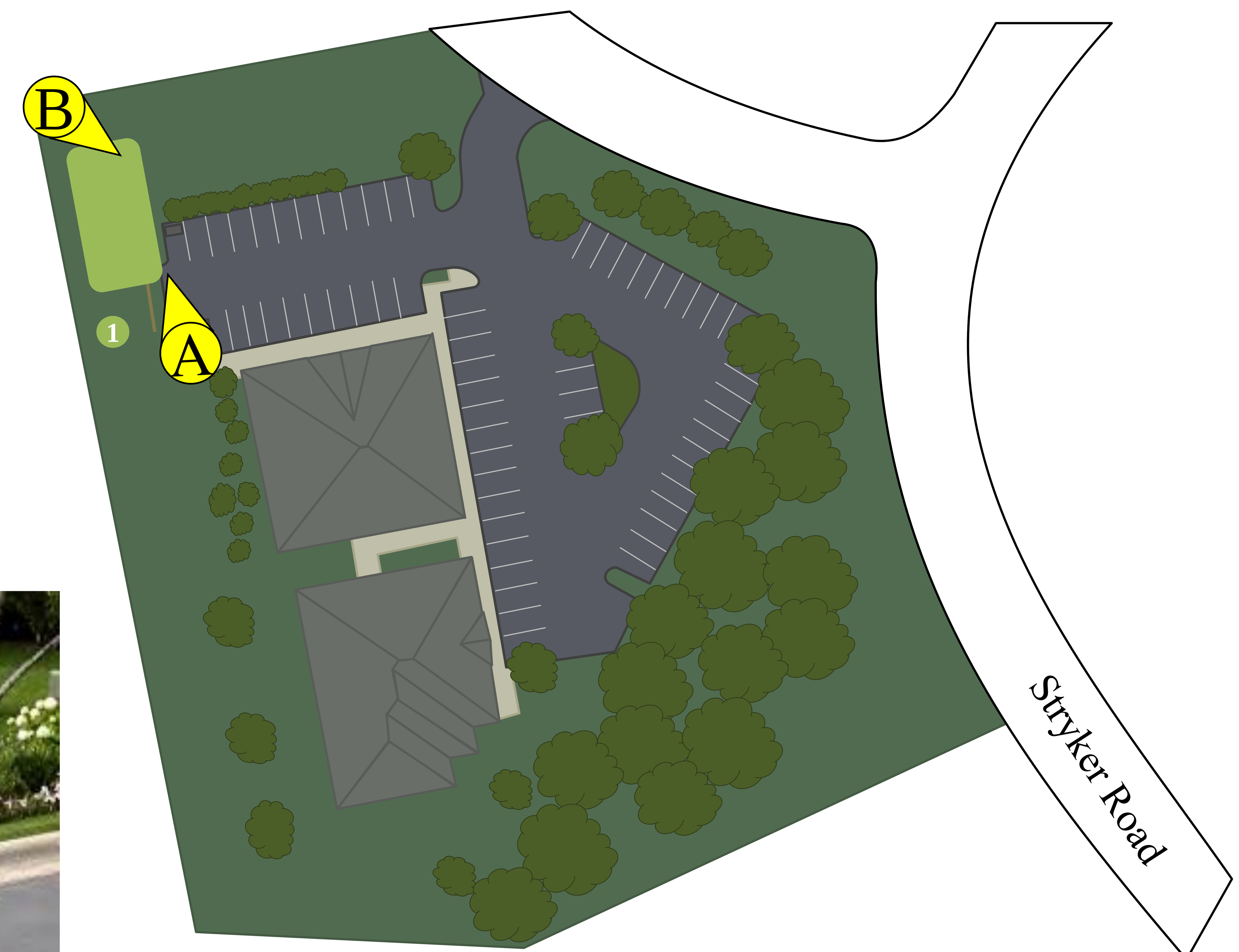
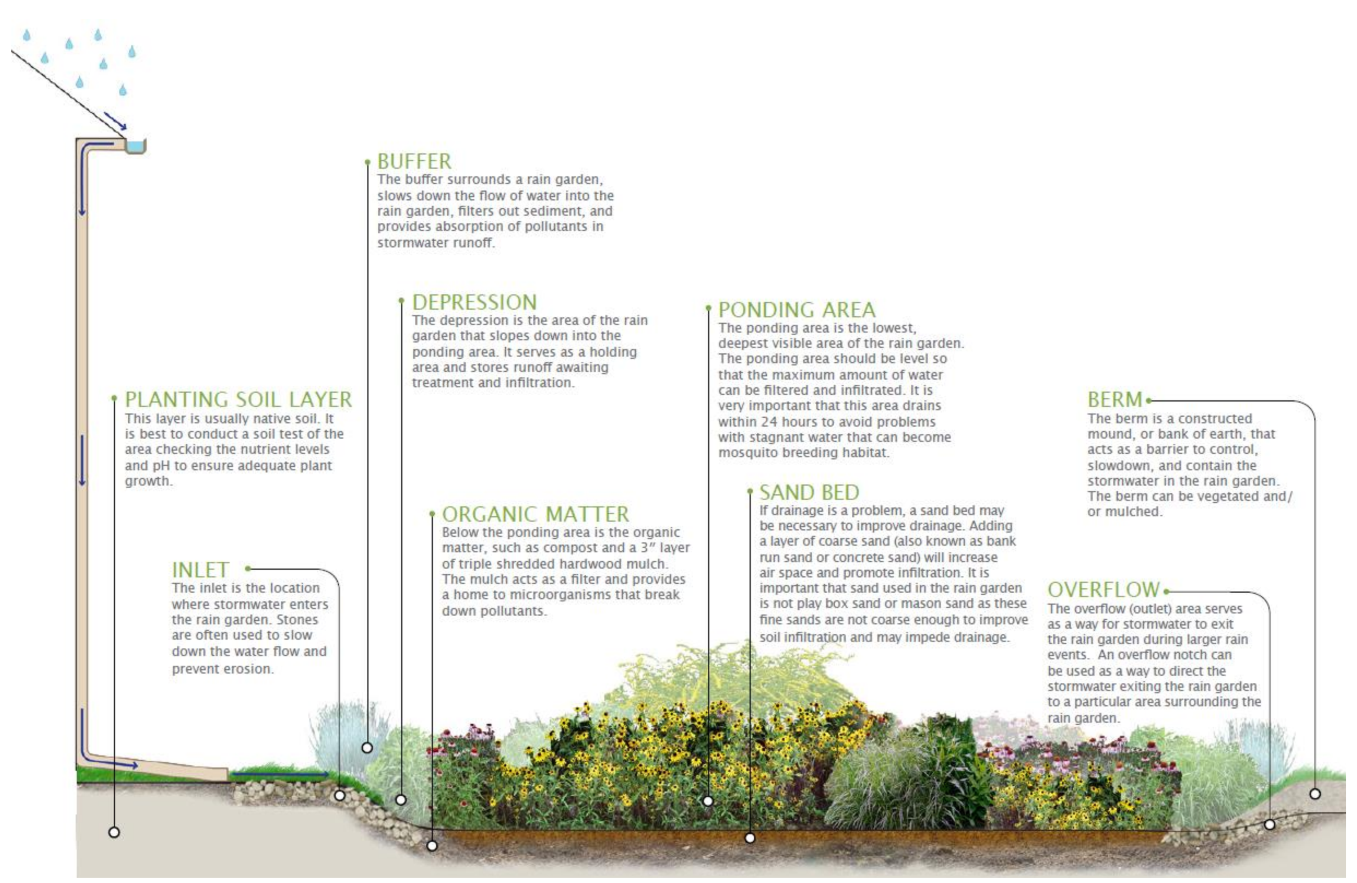


1 **BIORETENTION SYSTEM:** A rain garden could be installed west of the northern parking lot to capture, treat, and infiltrate runoff from the parking lot. The existing catch basin would alleviate the load during excessive rain events, however a majority of the runoff could be diverted to the rain garden through curb cuts. Curb cuts can be installed to carry stormwater into the proposed bioretention system. A bioretention system can reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping to the grounds. The bioretention system could also provide habitat for birds, butterflies, and pollinators.

1 BIORETENTION SYSTEM



CURB CUT

Location: 205 Stryker Road Phillipsburg, NJ 08865	**Municipality:** Lopatcong Township **Subwatershed:** Lopatcong Creek
Green Infrastructure Description: bioretention system (rain garden) curb cuts	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 187,600 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including paved walkways, driveways, parking areas, and building rooftops. These impervious surfaces are directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. The entire northern parking lot flows into a stormwater drain in the northwest corner of the lot. Significant sediment accumulation was also observed near this same drain. The pavement is in good condition.

Proposed Solution(s):
A large portion of the stormwater runoff from the northern parking lot could be effectively managed with a rain garden. The existing storm sewer system could be used to capture overflow from the system. The bioretention system would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. A rain garden could be installed along the northwest side of the parking lot. Stormwater would be conveyed to this garden through the use of curb cuts.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), this system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The bioretention system would also provide ancillary benefits such as enhanced wildlife habitat and aesthetic appeal.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Lopatcong Township
St. Luke's Village Health Center and its patrons
local social and community groups

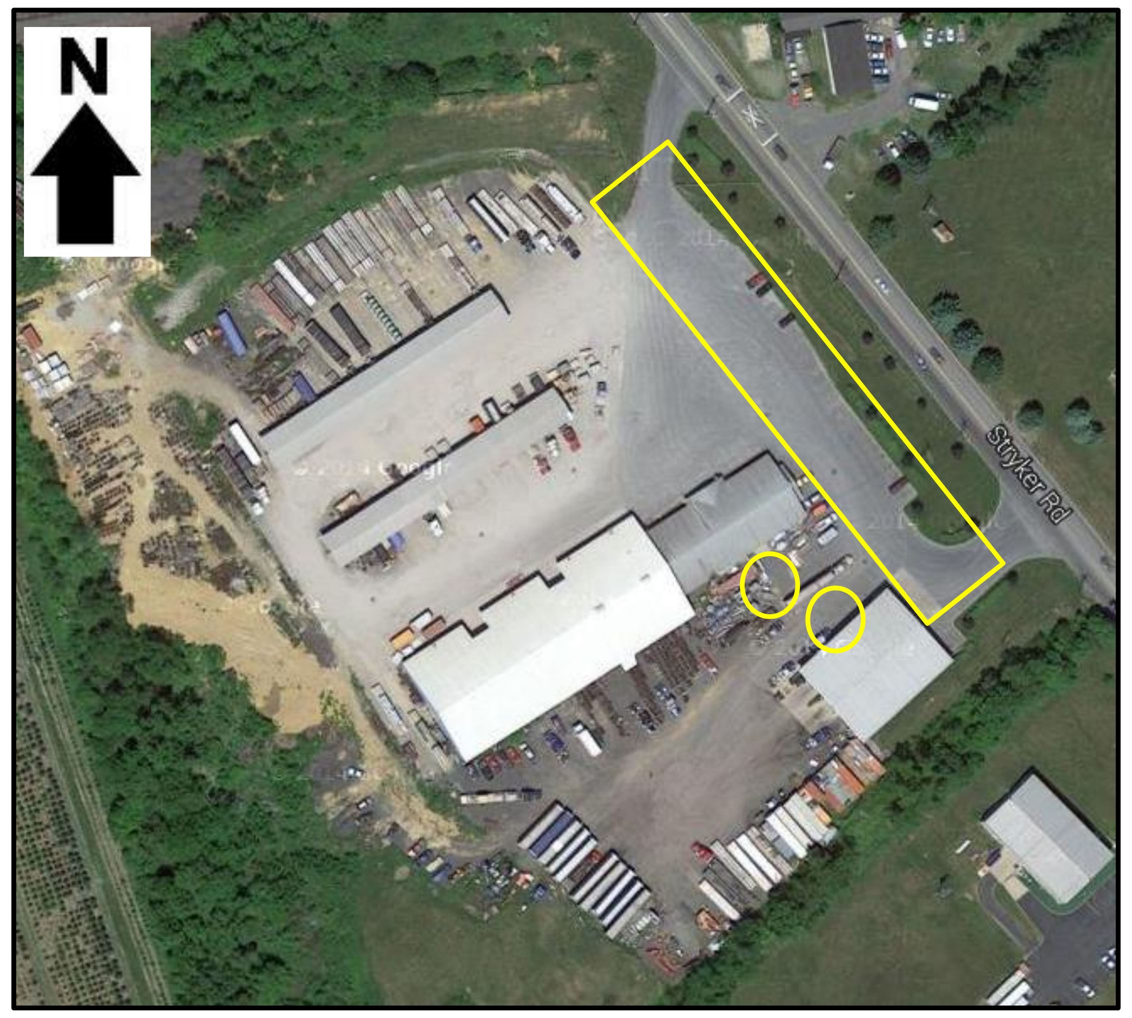
Partners/Stakeholders:
St. Luke's Village Health Center and its patrons
local community groups (Boy Scouts, Girl Scouts, etc.)

Rutgers Cooperative Extension
Estimated Cost: The rain garden on this property would need to be approximately 1,800 square feet. At $5 per square foot the estimated cost of the rain garden is $9,000.

Lopatcong Township
Impervious Cover Assessment
JHM Communications, 199 Stryker Road

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



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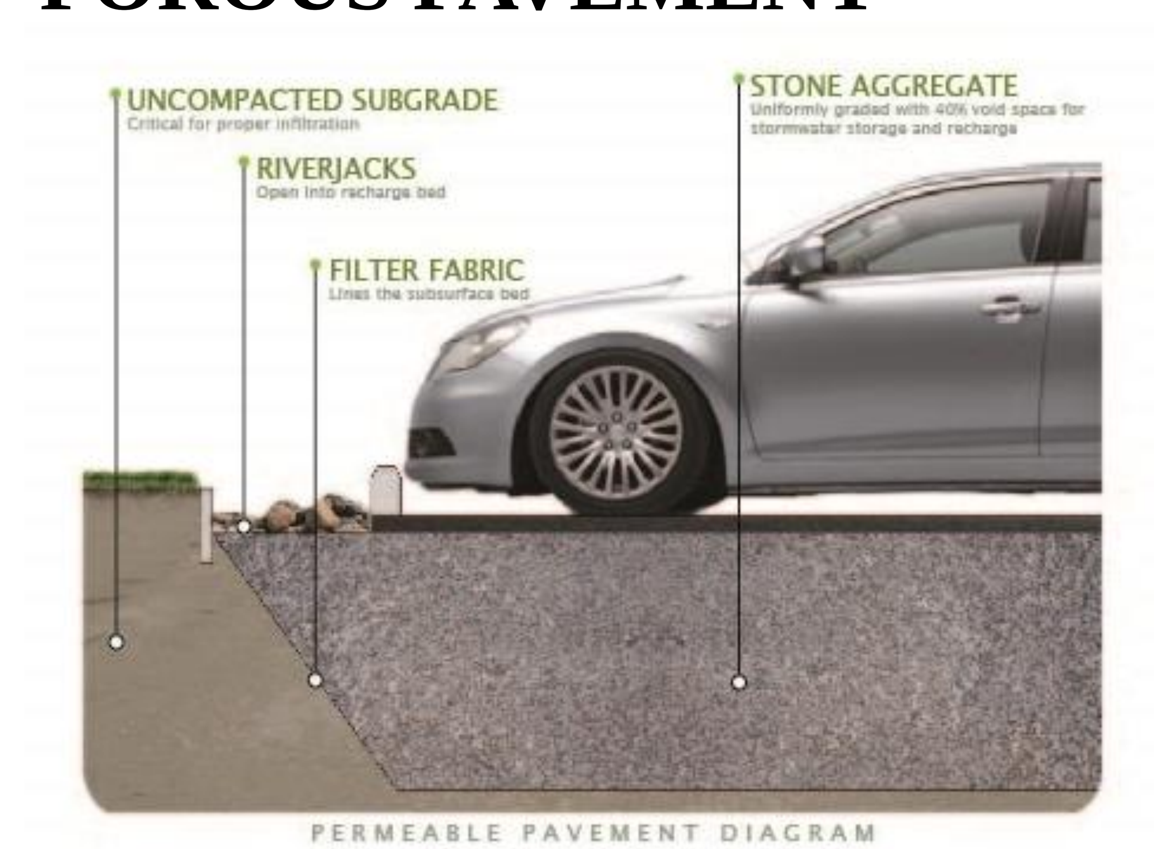
1 **RAINWATER HARVESTING SYSTEM:** Cisterns could help capture the stormwater that drains from the building's rooftop. Connecting the downspouts to the cisterns would allow the stormwater to be collected and used for washing trucks.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and filters stormwater.

SITE PLAN:

1 RAINWATER HARVESTING SYSTEM

2 POROUS PAVEMENT



Location: 199 Stryker Road Phillipsburg, NJ 08865	**Municipality:** Lopatcong Township **Subwatershed:** Lopatcong Creek
Green Infrastructure Description: porous pavement rainwater harvesting system (cisterns)	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** cistern #1: 43,200 gal. cistern #2: 51,800 gal. porous pavement #1: 149,800 gal. porous pavement #2: 251,400 gal. porous pavement #3: 858,500 gal.

Existing Conditions and Issues:

This site contains several impervious surfaces including driveways, buildings, warehouses, and parking areas. These impervious surfaces are directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. This site is located at the southwest corner of Stryker Road and Route 57, just south of the rail lines. There are two large buildings joined in a shipping complex in the center of the property, two large truck depots, and another building to the east. The roofs of the buildings contribute to impervious cover, and their downspouts are directly connected to sewer systems. There is sediment all over the paved surface of the lot, and the existing pavement on the site's main driveway is also in poor shape. Based on aerial imagery, the rear of the lot seems to be used for shipping containers and is severely eroded. It should be noted that this site is a shipping center. The grade of the lot is southwest to northeast; a detention basin is located out front.

Proposed Solution(s):

The downspouts on the northwest face of the eastern small building could be disconnected and rerouted to flow into cistern #1 to harvest rainwater from the roof. The downspouts on the south face of the northern small building could be disconnected and rerouted to flow into cistern #2. The main driveway and front parking lot could be strategically repaved with porous pavement to capture, treat, and infiltrate stormwater runoff from the site's extensive drainage areas. Porous pavement aprons could be installed at the front entrances to the property (porous pavement areas #1 & #2) to catch stormwater entering the roadway. The front parking area (porous pavement area #3) could be repaved with porous pavement to intercept stormwater prior to the detention basin. An additional possibility is that the detention basin could be retrofitted.

Anticipated Benefits:
Porous pavement allows stormwater to penetrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. Cisterns can harvest stormwater which can be used for washing the company trucks at the site. This would cut back on the use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when there is a chance of freezing).

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
property maintenance funds
Lopatcong Township
local social and community groups

Partners/Stakeholders:
Lopatcong Township
JHM Communications (and other businesses on the property)
local community groups
Rutgers Cooperative Extension

Estimated Cost:
Cistern #1 would need to be 3,000 gallons and cost approximately $6,000 to purchase and install. Cistern #2 would need to be 4,000 gallons and cost approximately $8,000 to purchase and install. Porous pavement area #1 would cover 1,050 square feet and have a 2 feet deep stone reservoir under the surface. At $25 per square foot, the cost of the porous pavement system would be $26,250. Porous pavement area #2 would cover 1,400 square feet and have a 2.5 feet deep stone reservoir under the surface. At $27.50 per square foot, the cost of the porous pavement system would be $38,500. Porous pavement area #3 would cover 3,920 square feet and have a 3 feet deep stone reservoir under the surface. At $30 per square foot, the cost of the porous pavement system would be $117,600. The total cost of the project will thus be approximately $196,350.